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Abstract: Duck nesting was studied during 1971 in north-central South Dakota under four conditions: in idle, five or six year old fields of domestic grass-legume mixtures in an area where predators including the red fox (*Vulpes fulva*), raccoon (*Procyon lotor*), striped skunk (*Mephitis mephitis*), and badger (*Taxidea taxus*) were (1) reduced and (2) not reduced. Nesting was also studied in tracts of active agricultural land (primarily croplands and pastures) where predators were (3) reduced, and (4) not reduced. Under condition (1), 260 nests were found on 0.87 km² (299 nests/km²) eggs hatched in 92 percent of the nests and production was 22.0 ducklings/hectare. Under condition (2), 187 nests were found on 2.22 km² (84 nests/km²), nest success was 68 percent and 4.7 ducklings/hectare were produced. On active agricultural land subject to predator reduction (condition 3), 61 nests were found on 5.14 km² (12 nests/km²). Eggs in 85 percent of the nests hatched and production was 0.7 duckling/hectare. On active agricultural land not subject to predator reduction (condition 4), 58 nests were found on 4.01 km² (14 nests/km²), nest success was 51 percent and 0.5 duckling/hectare was produced. Idle, 16 to 65-hectare (40 to 160-acre) stands of cool-season, introduced grasses in combination with legumes produced maximum numbers of upland nesting ducks.

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Environments for breeding waterfowl must include attractive and secure nesting sites to assure high rates of reproduction. Because ducks are primarily aquatic birds, waterfowl agencies usually have emphasized preservation and management of wetlands. Acquisition and management of upland nesting habitat have not received emphasis in proportion to their importance.

Predation and certain land uses are major factors which suppress reproductive success of upland nesting ducks in the prairie pothole region of North America (Higgins and Kantrud 1973, Miller 1971, Milonski 1958). Our paper presents data concerning relationships between duck production, land use, and predation in north-central South Dakota during 1971. Studies of waterfowl production in relation to land use were begun in western Edmunds County as a project of the Northern Prairie Wildlife Research Center (NPWRC) in 1967 (Duebbert 1969).

The objective of this study was to determine the effects of predator reduction on the productivity of ducks as related to quality of nesting habitat. A predator reduction program was conducted by the South Dakota Department of Game, Fish and Parks (SDGFP) (Trautman et al. 1966, Trautman and Fredrickson 1968). Under this program, numbers of red foxes, raccoons, striped skunks, and badgers were reduced in order to determine their influence on pheasant (*Phasianus colchicus*) populations. These mammals are the principal predators of breeding ducks, eggs, and ducklings in the area under study (H. F. Duebbert, unpublished data). One of four 259-km² (10- × 10-mile) predator control areas established by the SDGFP lent itself well to our investigation. This area contained diversified agricultural land use and numerous, high-quality, natural basin wetlands supporting medium to high densities of breeding ducks.

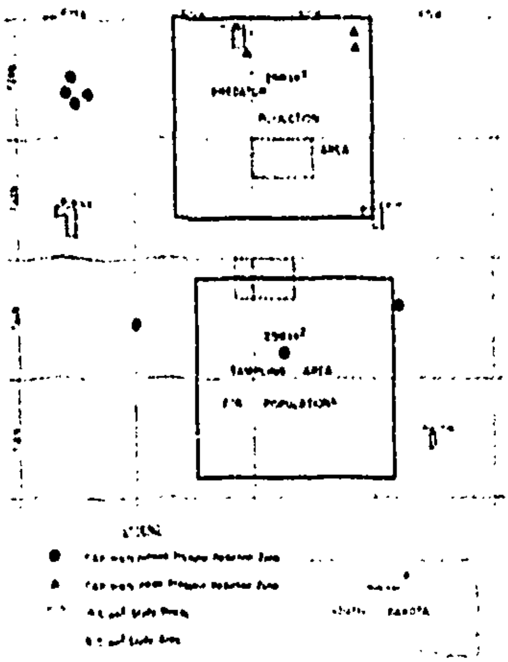

Fig. 1. Map of study areas.

Waterfowl-land use studies conducted by biologists from NPWRC during 1967–70 and findings of the SDGFP on the 259-km² area indicated that by the summer of 1970, predator populations had been reduced to very low numbers. During 1967 and 1968, the predator control program was limited by the fact that a mammal control specialist was available only on a part-time basis. The level of predator reduction attained under those conditions did not significantly improve duck production (H. F. Duebbert, unpublished data). Effective suppression of predators was attained only after the SDGFP employed a mammal control specialist to work intensively on the 259-km² area from May 1969 to August 1971.

Only during the 1971 breeding season were all conditions suitable for comparing duck nesting under four combinations of environmental factors—idle grasslands and active agricultural lands, each with and without predator control—in a single geographic area.

We acknowledge with thanks the assistance of H. W. Miller of NPWRC who provided supervision and helped with manuscript preparation. J. T. Lokemoen and G. M. Thomforde assisted with field work. R. Hodgins as Director of the South Dakota Department of Game, Fish and Parks allowed us to conduct waterfowl studies in the pheasant-predation study area. D. Badger and P. Dosch of SDGFP conducted the predator reduction program during the periods 1967–68 and 1969–71, respectively. Several landowners permitted us access to their lands. Their cooperation was essential to obtain the results reported here.

STUDY AREAS

CAP Fields with Predator Reduction

During 1966–67 the U.S. Department of Agriculture conducted the Cropland Adjustment Program (CAP) which required planting a grass-legume cover crop on idled cropland. Three plots of such idle grass-legume cover totaling 0.87 km² were located within the 259-km² predator reduction area (Fig. 1). Plot sizes were 0.17, 0.19, and 0.51 km². Nesting cover on the plots consisted of cool-season, introduced grasses and legumes. The 0.17-km² plot was idled in 1967 and had seeded cover consisting of smooth bromegrass (*Bromus inermis*), alfalfa (*Medicago sativa*), sweet clover (*Melilotus* spp.), and adventive coarse annual and biennial forbs. The 0.19-km² field was idled in 1967 and was dominated by a dense, uniform stand of smooth bromegrass and alfalfa. The 0.51-km² plot was idled in 1966 and was dominated by intermediate wheatgrass (*Agropyron intermedium*) and alfalfa. All fields contained large amounts of coarse natural mulch and abundant standing and lodged dead vegetation from previous growing seasons. Vegetation averaged 0.…-1.2 m in height on all fields.

CAP Fields without Predator Reduction

Seven CAP plots of idle grass-legume cover, totaling 2.22 km², were situated at scattered locations at least 8 km from the area of predator reduction. Plot sizes were 0.12, 0.21, 0.27, 0.28, 0.36, 0.44, and 0.54 km². All plots were idled in 1967. Vegetative composition varied slightly on the different plots, but smooth bromegrass, intermediate wheatgrass, and alfalfa were dominant species. Idle conditions during four growing seasons permitted a heavy build-up of natural mulch and standing dead vegetation. Height and density of cover were similar to that on fields where predators were reduced.

Wetlands comprised less than 5 percent of the total area in all CAP fields. Complexes of ephemeral (Class 1), temporary (Class 2), seasonal (Class 3), and semipermanent (Class 4) wetlands (Stewart and Kantrud 1971) occurred throughout the area under investigation. Total wetland density ranged from 8 to 16/km². Water conditions were such that breeding pair and brood habitat were adequate throughout the study period.

Active Agricultural Lands with Predator Reduction

A 15.5-km² (2- × 3-mile) study block was located 3.22 km within the predator reduction area in a zone of diversified land use typical of the region. Percent composition of land use for this block was: cropland, 44; native mixed-grass prairie pasture, 18; wetlands, 14; native mixed-grass prairie hayland, 9; idle mixed-grass prairie, 7; planted hayland, 5; roads and roadsides, 2; and trees and farmsteads, 1.

Nest searches were conducted on a total of 5.14 km² of land including 2.71 km² (53 percent) of small grain stubble, 1.06 km² (21 percent) of mixed-grass prairie haylands, 0.73 km² (14 percent) of mixed-grass prairie pastures, 0.27 km² (5 percent) of planted haylands, 0.26 km² (5 percent) of idle mixed-grass prairie, 0.06 km² (1 percent) of dry, shallow marsh vegetation, and 0.05 km² (1 percent) of bromegrass roadsides.

Active Agricultural Lands without Predator Reduction

This portion of the study was conducted on a 15.5-km² block of land in a zone of diversified land use located 6.44 km outside of the predator reduction area. This block had topography, soils, land use, wetlands, and breeding duck populations similar to the corresponding block in the predator reduction area, but no organized program of predator reduction was conducted. Percent composition of land use in this block was: cropland, 43; native mixed-grass prairie pasture, 30; wetlands, 9; planted haylands, 9; idle native mixed-grass prairie, 4; native mixed-grass prairie haylands, 2; roads and roadsides, 2; trees and farmsteads, 1.

Nest searches were conducted on a total of 4.01 km² of land including 1.64 km² (41 percent) of small grain stubble, 0.27 km² (7 percent) of mixed-grass prairie haylands, 1.01 km² (25 percent) of mixed-grass prairie pastures, 1.03 km² (26 percent) of planted haylands, and 0.06 km² (2 percent) of bromegrass roadsides.

Overgrazing for many years combined with the invasion of introduced plant species had degraded the quality of native grasslands on both 15.5-km² study blocks.

Extensive stands of Kentucky bluegrass (*Poa pratensis*), smooth bromegrass, and undesirable forbs were present. In addition, native grasses or grasslike plants which increase with heavy grazing in this area, such as blue grama (*Bouteloua gracilis*), buffalo grass (*Buchloe dactyloides*), and upland sedges (*Carex* spp.), were prevalent. Normal agricultural activities—grazing, haying, and tillage—prevented the accumulation of natural mulch and standing dead vegetation as components of nesting cover.

METHODS

Three methods were used to estimate populations of breeding ducks within or associated with the study areas. Each method involved one or more censuses of duck pairs during peak breeding periods between late April and early June. Locations of ducks were recorded on field maps at the time of each survey.

Censuses of breeding pairs in and around the 0.51-km² CAP field in the predator reduction area were made within an 8.13-km² circular area (1-mile radius) centered in the middle of the field. No censuses were conducted in and around the 0.17-km² and 0.19-km² CAP fields in the predator reduction area. Censuses were also conducted on each of the 15.5-km² study blocks. In addition, censuses of breeding pairs were conducted on 25 randomly selected 0.65-km² (0.5- × 0.5-mile) plots within the 259-km² predator reduction area. For comparison, censuses were made on 25 0.65-km² plots randomly selected within a 259-km² (10- × 10-mile) area 4.83 km south and 1.61 km east of the predator reduction area (Fig. 1). Land use patterns and wetland complexes were similar in each 259-km² area.

Nest searches on the study plots were conducted at intervals between late April and early July. A cable-chain device 53 m long was towed between two vehicles (Higgins et al. 1969) on all CAP fields to flush hens from their nests. In cases where the cable-chain device could not be used, nest searches in fields in the two 15.5-km² study blocks were conducted using a hand-pulled rope. The rope was 30.5 m long and had steel cans attached at 1.2-m intervals. In some haylands, nests were found by a visual search immediately following swathing operations. Nest markers consisting of 1.8-m slender, flagged willow switches were inserted in the ground about 2.4 m from active nests. Eggs were inspected to determine incubation stage (Weller 1956). Nest data were recorded on needle-sort punch cards manufactured by the Burroughs Corporation. To minimize disturbance, nests were not revisited until after the calculated hatch dates. Identification of nest predators was facilitated by use of techniques described by Rearden (1951) and Einarsen (1956). Nest density, the proportion of nests in which eggs hatched, and the number of hatched eggs per hectare of cover were used as major indicators of the relative attractiveness and productivity of the study plots.

Brood censuses were conducted in July and August within the 8.13- and 15.5-km² study plots. Data on broods are not included in the present analysis.

Land use and water conditions were recorded during censuses of breeding pairs and broods. This information was recorded on maps which were based on vertical aerial photographs. Information on history of the CAP fields was obtained from landowners and the Edmunds County Agricultural Stabilization and Conservation Service office in Ipswich.

Predator reduction methods on the 259-km² area included year-round poisoning, trapping, and shooting. An estimated total

Table 1. Duck nest densities and hatching success in different cover types with and without predator reduction in north-central South Dakota, 1971.

Cover types	Area with predator reduction				Area without predator reduction			
	km² searched	Nests found	Nests/km²	Percent hatched	km² searched	Nests found	Nests/km²	Percent hatched
Grain stubble	2.71	11	4	64	1.64	8	5	0
Prairie hayland	1.06	19	18	94	0.27	10	37	50
Prairie pasture	0.73	15	21	87	1.01	11	11	57
Idle prairie	0.26	8	31	100	0			
Tame hayland	0.27	2	7	100	1.04	26	25	64
Dry marsh	0.06	1	17	100	0			
Roadsides	0.05	5	100	67	0.73	0	0	0
Total, active agricultural land	5.14	64	12	85	4.01	58	14	51
Idle croplands (CAP)	0.87	260	299	92	2.22	187	84	68

of 1200 red fox, raccoon, striped skunk, and badger were removed (4.6/km²) from the population during the period 1 May 1969–31 October 1971 (Patrick Dosch, personal communication). Of the 1200 animals killed, poisoning, trapping, and shooting accounted for about 85, 10, and 5 percent, respectively. No attempts were made to control several other mammalian and avian predators of waterfowl known to inhabit the area.

RESULTS

CAP Fields with Predator Reduction

Results of the nesting studies are shown in Tables 1 and 2. On CAP fields in the predator reduction area, 260 duck nests were found on 0.87 km² (299 nests/km²) (Table 1). Eggs hatched in 228 (92 percent) of 249 nests with complete records. Duckling production was 22.0/hectare of upland cover.

The breeding population of dabbling ducks on the 8.13-km² circular area surrounding and including the 0.51-km² plot was 33 pairs/km². Numbers of indicated breeding pairs of each species were as follows (percentages of total in parentheses): mallard (*Anas platyrhynchos*), 76 (28); gadwall (*A. strepera*), 29 (11); pintail (*A. acuta*), 65 (24); American green-winged teal (*A. crecca*), 5 (2); blue-winged teal (*A. discors*), 64 (24); northern shoveler (*A. clypeata*), 27 (10); American wigeon (*A. americana*), 3 (1); total, 269 (100).

The 0.17- and 0.19-km² plots were located in similar terrain 6.4 km east of the 0.51-km² plot and we believe species composition and density of the breeding population were similar in all three areas.

CAP Fields without Predator Reduction

Results of nest searches on the seven plots (total area 2.22 km²) of CAP land outside

Table 2. Percent composition of nests of species of dabbling ducks found in different habitats in areas with and without predator reduction.

Species	Habitats			
	CAP fields		Diversified agricultural land	
	Predator reduction	No predator reduction	Predator reduction	No predator reduction
Mallard	44	19	10	16
Gadwall	32	35	21	16
Pintail	7	8	25	20
Green-winged teal	1	0	3	3
Blue-winged teal	10	36	35	42
Northern shoveler	2	1	4	3
Wigeon	3	.r	1	0
Total	99	99	99	100

Table 3. Population densities of breeding ducks on sample plots in two 259-km² areas with and without predator reduction.[a]

Species	Area with predator reduction	Area without predator reduction
Mallard (*Anas platyrhynchos*)	5.02 ± 0.73 (20)[b]	2.70 ± 0.62 (15)
Gadwall (*A. strepera*)	3.09 ± 0.77 (12)	2.70 ± 0.85 (15)
Pintail (*A. acuta*)	7.34 ± 1.51 (29)[b]	3.09 ± 0.89 (17)
Green-winged teal (*A. crecca*)	1.12 ± 0.42 (4)	1.10 ± 0.58 (6)
Blue-winged teal (*A. discors*)	6.56 ± 1.20 (26)	6.93 ± 1.58 (38)
Northern shoveler (*A. clypeata*)	1.93 ± 0.50 (8)	1.16 ± 0.42 (6)
Wigeon (*A. americana*)	0.39 ± 0.27 (1)	tr (tr)
Redhead (*Aythya americana*)	tr (tr)	0.39 ± 0.27 (2)
Canvasback (*Aythya valisineria*)		tr (tr)
Ruddy duck (*Oxyura jamaicensis*)		tr (tr)
Total	25.48 ± 1.09 (100)	18.13 ± 4.67 (100)

[a] Density in pairs/km², mean ± SE. Figures in parentheses indicate percent of total.
[b] Significantly ($P<0.05$) higher mallard and pintail populations in predator reduction area.

of the predator reduction area are shown in Tables 1 and 2. On these plots 187 nests were found (84 nests/km²). Of 168 nests with complete records, eggs hatched in 114 (68 percent). Production of 4.8 ducklings/hectare of upland cover was recorded.

The breeding populations in the vicinity of these plots were not determined. However, results of the random sample survey (Table 3) in this area provide a general approximation of the population structure.

Active Agricultural Lands with Predator Reduction

In the 15.5-km² block of diversified agricultural land subject to predator reduction 64 nests were found on the 5.14 km² searched (12 nests/km²) (Table 1). Eggs hatched in 46 (85 percent) of 54 nests with complete records. Ducklings were produced at the rate of 0.8/hectare of upland cover.

The indicated breeding population of dabbling ducks in this block (percentage of total in parentheses) was: mallard, 41 (16 percent); gadwall, 35 (13); pintail, 68 (26); American green-winged teal, 10 (4); blue-winged teal, 76 (29); northern shoveler, 30 (11); American wigeon, 2 (1); total, 262 (100). The population density on this block was 17 pairs of dabbling ducks/km².

Active Agricultural Lands without Predator Reduction

In the 15.5-km² block of diversified agricultural land where predators were not reduced, 58 nests were found on the 4.01 km² searched (14 nests/km²) (Table 1). Of 57 nests with complete records, eggs hatched in 29 (51 percent). Production of 0.5 duckling/hectare of upland cover was recorded.

The indicated breeding population of dabbling ducks in this block (percentage of total in parentheses) was: mallard, 51 (16); gadwall, 49 (15); pintail, 55 (17); American green-winged teal, 9 (3); blue-winged teal, 126 (40); northern shoveler, 25 (8); American wigeon, 3 (1); total, 318 (100). The population density was 20 pairs of dabbling ducks/km².

Results of the random sample survey of breeding populations in the two 259-km² areas (Fig. 1) are shown in Table 3. This survey indicated that the density of breeding mallards and pintails was significantly ($P < 0.05$) greater in the predator reduction area.

Cessation of Predator Control

The following data suggest that any beneficial effects on duck production from direct predator control on active agricultural lands are of short duration. The effects of the predator control program ceased as of 31 October 1971 (Patrick Dosch, personal communication). Studies were continued in 1972 on the paired 15.5-km² blocks to determine the amount of time required for predators to reinvade the area. In 1972, eggs in 69 percent of the nests observed on the predator reduction block hatched as compared to 60 percent of the nests on the block without predator reduction. Nest densities on the two areas were 17 and 25 nests/km², respectively. These results indicate that within 9 months, predation rates were very similar in both blocks. In 1972, red foxes and striped skunks caused the destruction of 19 percent and 41 percent, respectively, of the nests on the block where predators had been controlled through October of 1971. In 1971 no nests were lost to foxes and only one to skunks.

Only the 0.51-km² CAP field was available for study within the former predator reduction area in 1972. The 0.17- and 0.19-km² fields were removed from the CAP by the owner. Duck production remained very high on the 0.51-km² field on which 323 nests were found (633/km²). Of 313 nests with complete records, eggs hatched in 90 percent. Ten CAP fields with a total of 2.87 km² were studied in the region where predator control had not been conducted. On these fields 386 nests were found (134/km²). Of 372 nests with complete records, 58 percent contained hatched eggs.

DISCUSSION

The results indicate that the type of cover available to dabbling duck hens at onset of nesting is an important factor in nest site selection. Reduction of predators to very low numbers did not greatly increase net duck production as indicated by a hatch of 0.8 vs. 0.5 duckling/hectare on active agricultural lands with and without predator reduction, respectively. Low production on these lands was primarily the result of low nest densities in the types of cover that were available. The proportion of nests containing hatched eggs was markedly higher on active agricultural lands subjected to intensive predator reduction, but in terms of overall duck production the greater nest success did not compensate for low nest density.

In the areas subjected to predator reduction the observed nest density was nearly 25 times greater in idle grass-legume (CAP) cover than in the usual nesting habitat available on active agricultural land (299 vs. 12 nests/km²). Nest success was similar, 92 and 85 percent on the high quality and low quality habitats, respectively.

These findings also indicate that if intensive, continuous control is directed at the principal predators of waterfowl in the glaciated prairie region, their numbers can be reduced and maintained at very low levels. The high degree of control attained on our study area required the intensive work of one skilled predator reduction specialist.

A finding relevant to management of waterfowl production habitat resulted from our study. Blocks (0.12–0.54 km²) of idle grassland containing tall, dense, rank cover in the area without predator reduction produced 6 times as many ducks as lands containing the usual covers available for nesting ducks in the area where predators were reduced (4.8 vs. 0.8 duckling/hectare). This substantiates a principle of wildlife management, that establishment and maintenance of excellent habitat is a sounder practice than direct reduction of predators (Grange 1949:10–11, Komarek 1966). Nevertheless, in our opinion, the rational reduction of predators can be justified to attain high duck production on areas devoted to special management which contain excellent nesting cover and dense breeding populations. Conversely, predator reduction in areas which do not have an abundance of prime nesting cover will not result in greatly increased duck production. Idle grasslands (CAP) produced over four times as many ducklings in the area where predators were reduced as where they were not (22.0 vs. 4.8 ducklings/hectare). Lowest production of all occurred in covers on active agricultural land where predators were not reduced (0.5 duckling/hectare). This is the usual condition in areas of diversified land use in the glaciated prairie pothole region.

The random sample survey of breeding duck populations indicated significantly higher populations of mallards and pintails in the area where predators were reduced. Consequently, it may be speculated that the predator reduction program resulted in greater survival of nesting hens, increased nesting success, and subsequently higher homing rates for females of these species.

Throughout most of their range in the north-central United States and south-central Canada, nesting ducks are subject to high rates of predation (Keith 1961, Moyle 1964, Stoudt 1971). At the same time, ethical and economic restraints sharply curtail the application of direct predator control measures. On 9 February 1972, President Nixon issued Executive Order 11643 which essentially prohibited Federal agencies from using chemical toxicants for killing predatory mammals and birds.

It is important to find ways other than direct predator control to reduce predation rates on breeding waterfowl. Skillful habitat manipulation offers an alternative. We have shown that establishment of stands of cool-season, introduced grasses in combination with legumes on blocks (40–160 acres) of retired cropland results in high production of upland nesting ducks. General observations throughout the eastern Dakotas indicate that intermediate wheatgrass and tall wheatgrass (*A. elongatum*) in combination with sweet clover and alfalfa constitute highly desirable cover when established on abandoned or idled cropland. To be of maximum value for duck nesting we believe it is necessary to maintain such cover in idle status for approximately 5 or 6 years. In later years, reductions in height and density of planted vegetation combined with associated environmental changes in the habitat reduce its value as nesting cover. Thus, periodic manipulation of the cover by mechanical treatments, prescribed burning, or other methods of rejuvenation probably will be required to maintain the vegetation in a vigorous, robust growth form.

LITERATURE CITED

DUEBBERT, H. F. 1969. High nest density and hatching success of ducks on South Dakota CAP land. Trans. N. Am. Wildl. Nat. Resour. Conf. 34:218–229.

EINARSEN, A. S. 1956. Determination of some

predator species by field signs. Oregon State Monogr. Stud. in Zool. 10. 31pp.
GRANGE, W. B. 1949. The way to game abundance. Charles Scribner's Sons, New York. 365pp
HIGGINS, K. F., L. M. KIRSCH, AND I. J. BALL, JR. 1969. A cable-chain device for locating duck nests. J. Wildl. Manage. 33(4):1009–1011.
———, AND H. A. KANTRUD. 1973. Increasing bird nesting success on cultivated land. North Dakota Outdoors 35(9):18–21.
KEITH, L. B. 1961. A study of waterfowl ecology on small impoundments in southeastern Alberta. Wildl. Monogr. 6. 88pp.
KOMAREK, R. 1966. A discussion of wildlife management, fire and the wildlife landscape. Proc. Annual Tall Timbers Fire Ecol. Conf. 5: 177–191.
MILLER, H. W. 1971. Relationships of duck nesting success to land use in North and South Dakota. Trans. Congr. Int. Union Game Biol. 10:133–141.
MILONSKI, M. 1958. The significance of farmland for waterfowl nesting and techniques for reducing losses due to agricultural practices. Trans. N. Am. Wildl. Conf. 23:215–228.
MOYLE, J. B., ED. 1964. Ducks and land use in Minnesota. Minnesota Dept. Conserv. Tech. Bull. 8. 140pp.
REARDEN, J. D. 1951. Identification of waterfowl nest predators. J. Wildl. Manage. 15(4):386–395.
STEWART, R. E., AND H. A. KANTRUD. 1971. Classification of natural ponds and lakes in the glaciated prairie region. U. S. Bur. Sport Fish. Wildl. Resour. Publ. 92. 57pp.
STOUDT, J. H. 1971. Ecological factors affecting waterfowl production in the Saskatchewan parklands. U. S. Bur. Sport Fish. Wildl. Resour. Publ. 99. 58pp.
TRAUTMAN, C. G., W. L. TUCKER, P. F. SPRINGER, AND R. L. DAHLGREN. 1966. Fox-pheasant relationships in South Dakota, 1965. South Dakota State Univ. Exp. Stn. Circ. 176. 28pp.
TRAUTMAN, C. G., AND L. F. FREDRICKSON. 1968. Relationships of red foxes and other predators to populations of ring-necked pheasants and other prey. 1966–67. South Dakota Dept. Game, Fish and Parks. P-R Prog. Rep., Proj. W-75-R-9, Job F-8.2-9. 87pp.
WELLER, M. W. 1956. A simple field candler for waterfowl eggs. J. Wildl. Manage. 20(2): 111–113.

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